Remarks:

Reconsideration of the application is requested.

Claims 9-16 are now in the application. Claims 1-8 have been cancelled and claims 9-16 have been added.

In item 1 on page 2 of the above-identified Office action, the disclosure has been objected to.

The distance between the valence band and the conduction band is not measured. The invention is based on the knowledge that when electrons make a transition between the valence band and

what measure this current

the conduction band, a leakage current occurs and this leakage current lowers the retention time of a memory cell. The invention is also based on the knowledge that in a normal

whats

cell, an energy of 2.7 eV is required in order to make this transition. By using an energy that is lower than 2.7 eV, i.e.

how would you measure/know this transition.

2.5 eV, a transition will not occur in these normal cells, however, transitions will occur in defective cells in which the distance between the valence band and the conduction band is small compared with a normal cell. These transitions will

Not in claim

increase the leakage currents in the defective cells and thus

9.

lower the retention time. Since the increased leakage currents in the defective cells lower the retention time, the defective cells can then be accordingly determined in the standard way,

Not in claim

i. e. by now measuring the data presently being stored and

comparing the measured data with the data that was written into the cells.

In item 2 on page 2 of the above-identified Office action, the disclosure has been objected to.

Nothing actually determines that an electron has made a transition. One just utilizes the knowledge that transitions will occur in defective cells and will not occur in normal cells when one irradiates the wafer with an irradiation energy that is slightly lower than the energy required for a transition in a normal cell.

With regard to the question regarding the energy, it is a physical phenomenon that the distance between the valence band and the conduction band is smaller in the defective cells. By using irradiation with a wavelength having sufficient energy, electrons can be made to transition in any cell, however, by using a wavelength having an energy that is slightly lower than the energy required for transitions in normal cells, transitions will only occur in defective cells.

With regard to item 3, no energy is measured.

With regard to item 4, the distance is not measured.

With regard to item 5, it is known that by providing sufficient energy, a transition can be made to occur from the valance band to the conduction band. Nothing is being determined here.

With regard to item 6, since the remaining test steps are identical to that performed in the prior art, the remaining steps have not been described in great detail, however, one of ordinary skill in the art can refer to page 1, lines 24-26 and to page 11, lines 2-3 and lines 11-15 to see how the known procedure relates to the inventive procedure.

With regard to item 7, the light source is switched on to expose memory cells on the wafer that will be tested and is then switched off after a predetermined time.

With regard to item 8, the defective memory cells are determined by measuring data stored in the memory cells after the light has been projected onto the wafer and comparing this measured data with the data that was written into the cells. The distance is not measured.

With regard to item 9, the voltage supply powers the chips so that they can operate during the test.

With regard to item 10, a transition is not determined.

With regard to item 11, the stored information is the same data that has been written into the normal cells, however, in the defective cells, the data will have changed because of the leakage currents that have been generated by the light.

On pages 4-7 of the above-identified Office action, claims 1-8 have been rejected under 35 U.S.C. § 112, first paragraph.

Claims 1-8 have been cancelled.

The rejections relating to a "device for measuring the distance between the conduction band and the valence band" should be cleared up by referring to the discussions provided above.

The rejections relating to a "device for comparing the distance between the conduction band and the valence band" should be cleared up by referring to the discussions provided above.

The rejections relating to a "device for detecting electron transfer" should be cleared up by referring to the discussions provided above.

It should be clear that no such devices are necessary in order to perform the invention.

The rejection relating to the device for writing to the memory cells has been responded to by directing the claims toward a method of enabling testing of the semiconductor devices. After the semiconductor devices have been irradiated with the light, testing can commence by comparing the data previously written into the semiconductor devices with the data now being read out.

On paragraph 4 on page 7 of the above-identified Office action, claims 1-8 have been rejected under 35 U.S.C. § 112, second paragraph.

It should now be clear that none of the cited devices are part of essential structural relationships of now-cancelled claims 1-8, with the possible exception of the writing device.

The rejection relating to the device for writing to the memory cells has been responded to by directing the claims toward a method of enabling testing of the semiconductor devices. After the semiconductor devices have been irradiated, testing can commence by comparing the data previously written into the semiconductor devices with the data now being read out. See,

Not in claims

for example, the specification at page 11, lines 1-3 and 11-15 as well as page 1, lines 21-26.

It is accordingly believed that the specification and the claims meet the requirements of 35 U.S.C. § 112, first paragraph. Should the Examiner find any further objectionable items, counsel would appreciate a telephone call during which the matter may be resolved. The above noted changes to the claims are provided solely for the purpose of satisfying the requirements of 35 U.S.C. § 112. The changes are neither provided for overcoming the prior art nor do they narrow the scope of the claims for any reason related to the statutory requirements for a patent.

Not in claims

Applicant would like to further discuss the invention in general. Applicant believes that the Examiner does not clearly understand: the context between the leakage currents and the decrease in data retention time (see page 2, lines 1-6); the context between the irradiation and the production of leakage currents (page 3, line 22 through page 4, line 14; as well as the general concept and advantage of the transition from electrons from the valence band into the conduction band (page 4, lines 14-18).

Not in spec. at least at page 2 lines 1-6

Applicant notes the following:

Semiconductor devices - particularly having leakage currents which are too large - will be separated using test devices and test methods. For this purpose, the semiconductor devices are commonly subjected to temperature treatments, which provide for an artificial aging. This process has the disadvantage of relatively long waiting times for the artificial aging to occur so that this results in correspondingly long test times (page 2, lines 1-15)

The reason for the leakage currents is that too many charge carriers are present in the semiconductor body of the semiconductor devices being tested. These charge carriers stem from valence bands having too small a distance to the conduction band. With only a slight excitation, the electrons then get from the valence bands into the conduction band and thus lead to leakage currents (page 3, lines 16 to 20). This effect is used in the instant invention.

Using an adjustable light source, i.e. a light source, whose frequency can be controlled, light is radiated onto the semiconductor body of the semiconductor devices that will be tested. The frequency of the radiated light is thereby adjusted such that the energy is below the normal distance between the valence band and the conduction band.

With regard thereto, applicant refers to Fig. 2 of the enclosed new drawing sheet.

The lower half of this new Fig. 2 shows a valence band and a conduction band for a "good" semiconductor device and for a "faulty" (poor) semiconductor device. It is thereby assumed that the good semiconductor device has a band distance of 2.7 eV, while the band distance in the faulty semiconductor device is 2.5 eV (See page 9, lines 1-9 for support).

Obviously, the band distance for good semiconductor devices is known for the individual materials. Applicant refers, for example, to the old-familiar book "Introduction to solid state physics" by Ch. Kittel, second edition, 1965, pages 347 to 382. There, such band models with a conduction band and a valence band are shown in Fig. 13.1 on page 348 and in Fig. 13.6 on page 358. The forbidden band between the valence band and the conduction band has an energy width Eg (see Fig. 13.1). For this energy width, silicon has a value of 1.10 eV (see table 13.1 on page 351). This is an undoped silicon.

If in a semiconductor body the distance between the valence band and the conduction band for good semiconductor devices is 2.7 eV, faulty semiconductor devices can be excluded, i.e. those in which the distance between the valence band and the conduction band is too small. According to the invention this

takes place in that light with 2.5 eV, for example, is irradiated on the semiconductor devices. If those with a band distance of 2.5 eV are present, the electrons thereof reach from the valence band into the conduction band and thus show an excessive leakage current. These faulty semiconductor devices can then be separated without a problem.

Due to the fact that the light source 4 can be adjusted or tuned, it can be brought to values of below 2.7 eV in order to thus be able to determine all semiconductor devices in which the band distance between the valence band and the conduction band is smaller than 2.7 eV.

Fig. 2 of the new drawing sheet additionally shows an optical waveguide which can, for example, be present instead of the light source 4 in order to thus irradiate light onto the wafer 3 (See page 6, lines 6-15 for support). Naturally, this optical waveguide must then be provided with a corresponding light source at the end opposite the wafer 3.

The retention time of memory cells, i.e. the data retention time, depends on their leakage currents. The larger the leakage currents, the shorter the retention time.

In the device used in the invention, a test program which runs in the wafer sampler 1, is controlled by the control unit 5.

For this purpose, the memory chips of the wafer 3 are described in a completely common manner. In other words, information "0" or "1" is stored in these memory chips.

Up to this stage, the test process is completely identical with that of the prior art.

However, instead of then carrying out an artificial aging by using a temperature treatment, an irradiation with light takes place in the invention. By using this light, all of those semiconductor devices of the semiconductor chips are separated, which have leakage currents. In other words, those semiconductor devices are determined, whose data retention time is too low due to leakage currents that are too high.

The determination of the semiconductor devices that have thus been brought into the leakage current condition in turn takes place in a common manner.

The essential idea of the invention is thus to carry out a separation with the influence of radiant energy instead of an aging for a test run by using a temperature treatment.

In paragraph 5 on page 8 of the Office action, claims 1-8 have been rejected as being obvious over Bottka (5,365,334) under 35 U.S.C. § 102. Applicant respectfully traverses.

Although applicant believes that claims 1-8 are patentable over Bottka, these claims have been cancelled. Claims 9-16 have been added, which directly correspond to the cancelled claims.

As previously pointed out, the claims have been directed to a method of enabling testing of the semiconductor devices. After the semiconductor devices have been irradiated, testing can commence by comparing the data previously written into the semiconductor devices with the data now being read out. See, for example, the specification at page 11, lines 1-3 and 11-15 as well as page 1, lines 21-26.

Bottka shows a configuration for measuring the charge carrier concentration in a semiconductor body. In this configuration, a laser source 36 emits laser light onto the surface of a sample 12 via a light guide, by means of which electron-hole-pairs are generated in this sample 12 and the band distance between the valence band and the conduction band is locally changed.

Due to the so-called "Franz-Keldysh-effect", the thus injected charge carriers change the reflection ability of the sample. In order to measure the same, a light source 16 casts light to the laser-irradiated sample 12 via a light guide 14. Via a

further light guide 18, the reflecting light reaches photodetectors 32 which in turn are connected to an analyzer 44 which spectrally evaluates the light reflected by the sample 12 and registered by the detectors 32. It is thus possible to determine the charge carrier distribution in the sample 12.

Bottka thus contains the idea of determining the charge carrier distribution in a semiconductor body by generating electron-hole pairs and by evaluating the reflection ability generated thereby.

One of ordinary skill in the art, however, does not obtain any information therefrom to specifically transfer electrons into the conduction band in "faulty" memory cells in order enable one to separate these faulty memory cells in which a distance between the valence band and the conduction band is too small.

Claim 9 is patentable since it includes a step of: with a tunable light source, projecting light having a specific wavelength and a specific intensity onto the semiconductor devices for a predetermined time so that irradiated electrons in defective ones of the semiconductor devices, in which a distance between a valence band and a conduction band has a lower value as compared with that of defect-free ones of the

semiconductor devices, are transferred into the conduction band from the valence band.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 9.

Claim 9 is, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 9-16 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, he is respectfully requested to telephone counsel so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made.

Please charge any other fees which might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

For Applicant

Mark P. Weichselbaum
Reg. No. 43,248

MPW:cgm

March 17, 2003

Lerner and Greenberg, P.A.
Post Office Box 2480
Hollywood, FL 33022-2480
Tel: (954) 925-1100
Fax: (954) 925-1101